SimHumalator

A Human Radar Simulator

1. Important points for deciding the simulation parameters

i. Range resolution is dictated by the bandwidth swept by the chirp

$$\Delta_r = \frac{c}{2BW}$$

ii. Maximum range is limited by the ADC sampling frequency f_s

$$R_{max} = \frac{cf_s}{2\gamma}$$

iii. Doppler resolution depends upon the coherent processing interval

$$\Delta_{f_D} = \frac{1}{T_{CPI}}$$

iv. Maximum Doppler that can be detected is given by

$$f_{Dmax} = \pm\frac{PRF}{2}$$

$c = 3 \times 10^8$ m/s is the speed of light

$\gamma = \frac{BW}{T_{CD}}$ is the chirp factor

$PRF = \frac{1}{T_{PRI}}$ is the pulse repetition frequency

2. Simulator simulate human radar returns as a function of following parameters-

i. **Radar Parameters**

1. Radar Waveform Parameters
   - **a.** Carrier frequency (Hz)
   - **b.** Sampling frequency (Hz)
   - **c.** Bandwidth (Hz)
   - **d.** Pulse Repetition Frequency (PRF)
   - **e.** Duty Cycle of Chirp
   - **f.** Coherent Processing Interval (CPI)
2. Configuration of Radar
   - **a.** Monostatic
   - **b.** Bistatic Inline
   - **c.** Bistatic Circular

ii. **Target Parameters**

1. Activity type
2. File Number (Multiple files within each activity
3. Aspect angle of target with respect to radar
4. Initial location of target in space

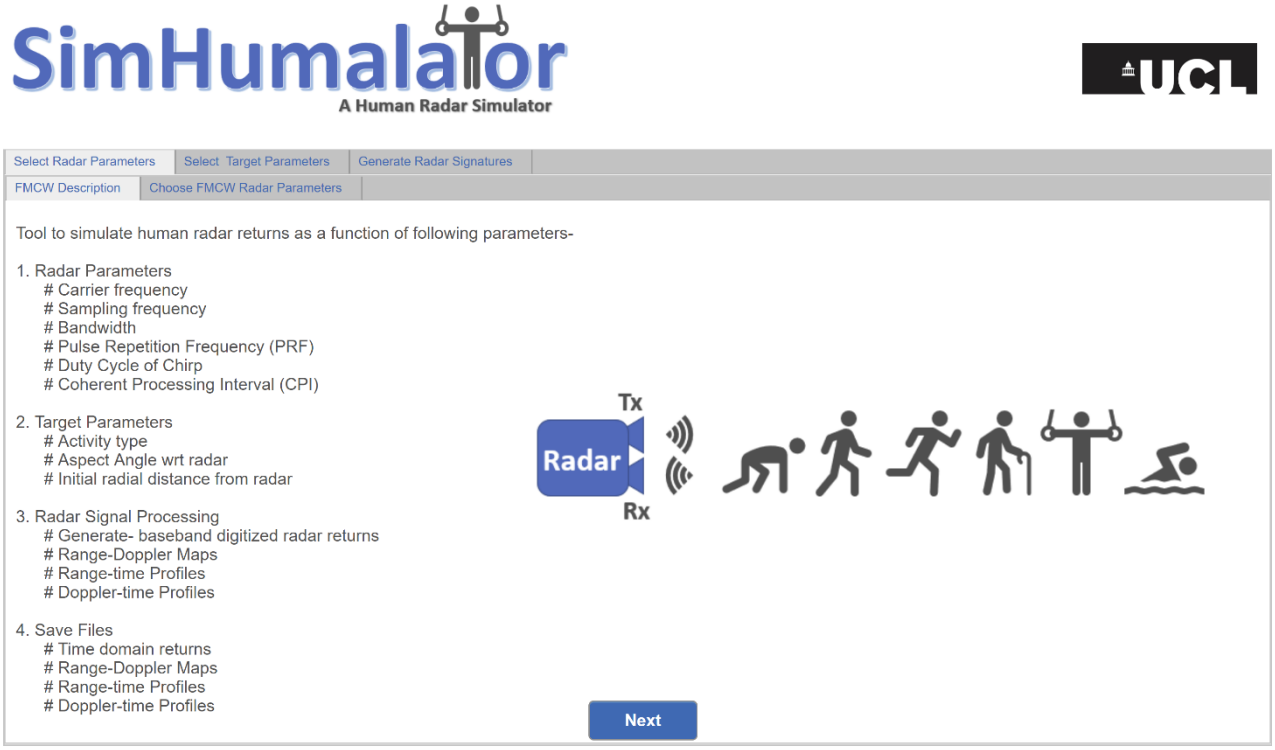
iii. **Radar Signatures Generated**

1. Baseband digitized radar returns

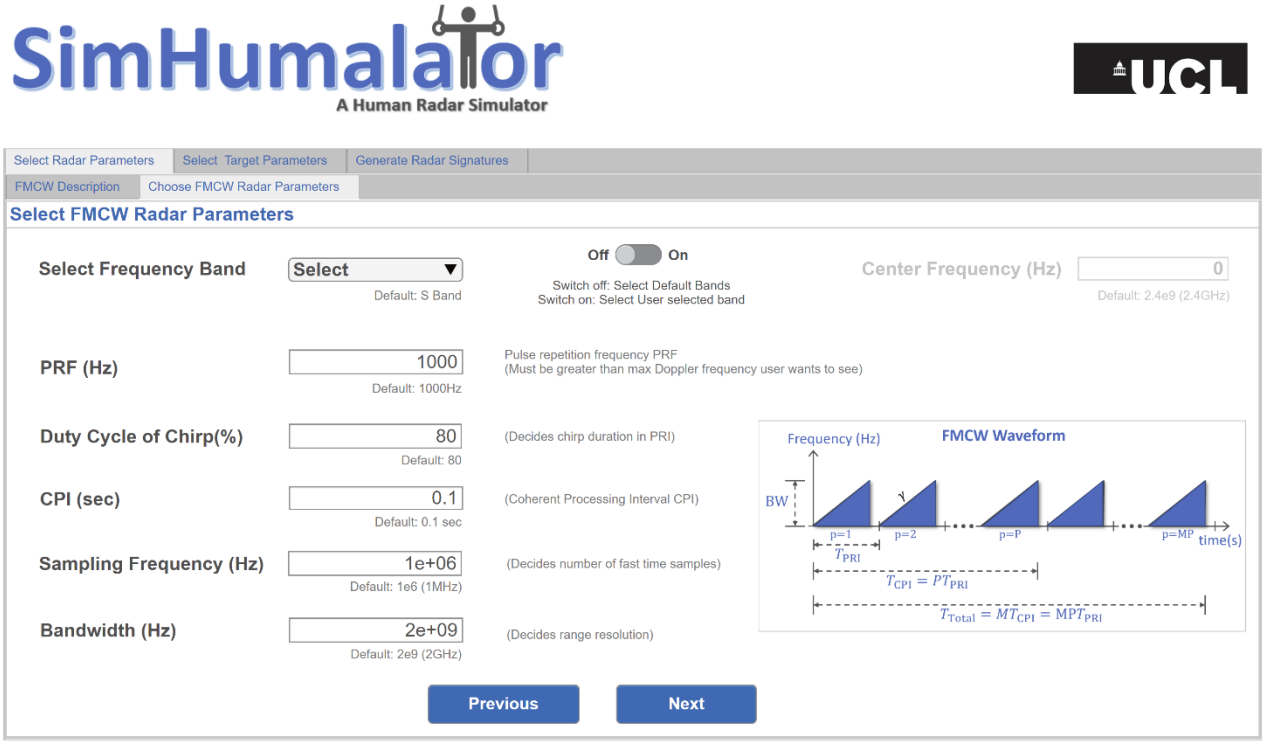
2. Range-Doppler Maps
3. Range-time Profiles
4. Doppler-time Profiles

3. Demonstration of the simulation

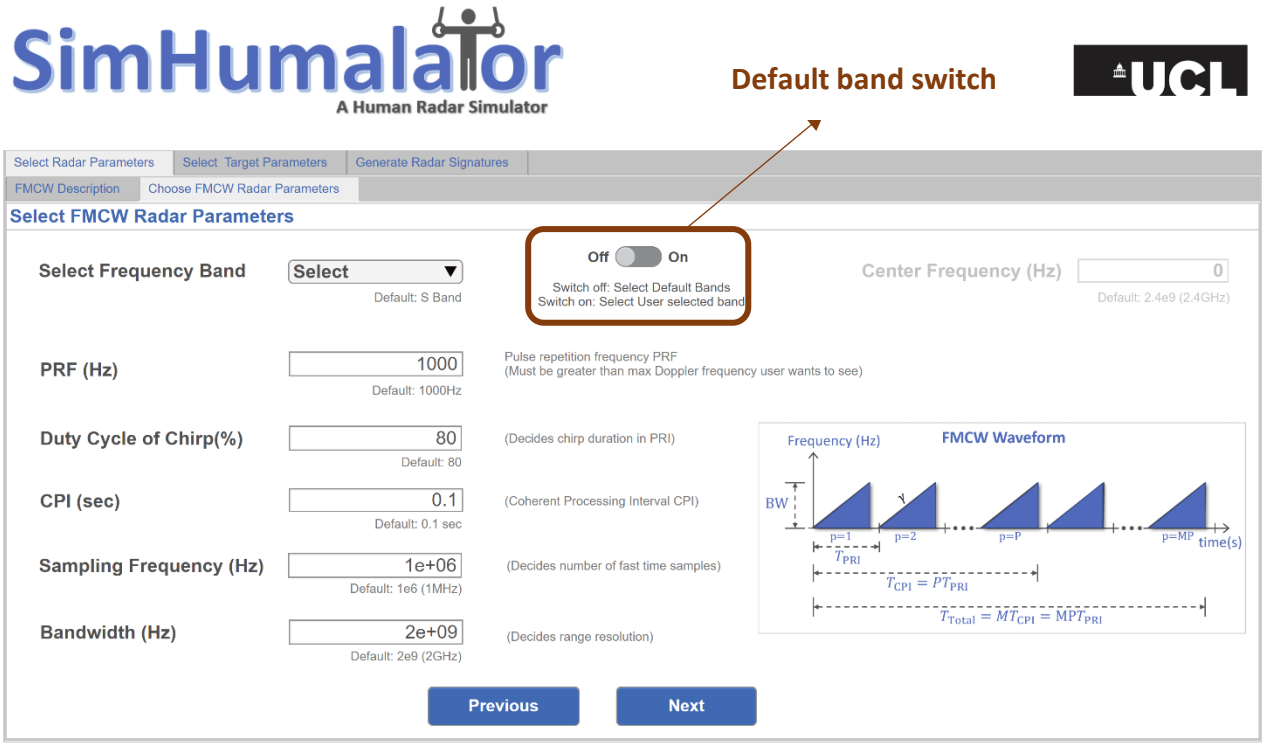
a. Run the app. The main page of the simulator would be



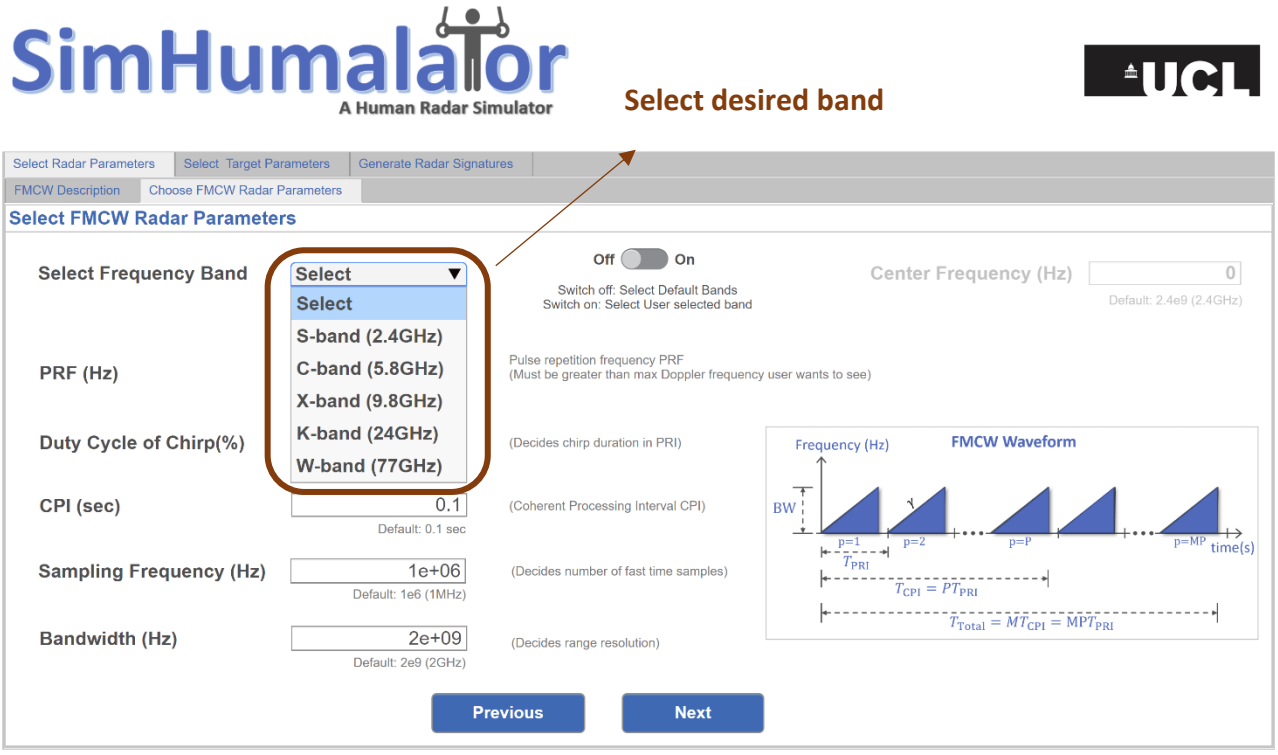
b. Press Next to select radar parameter



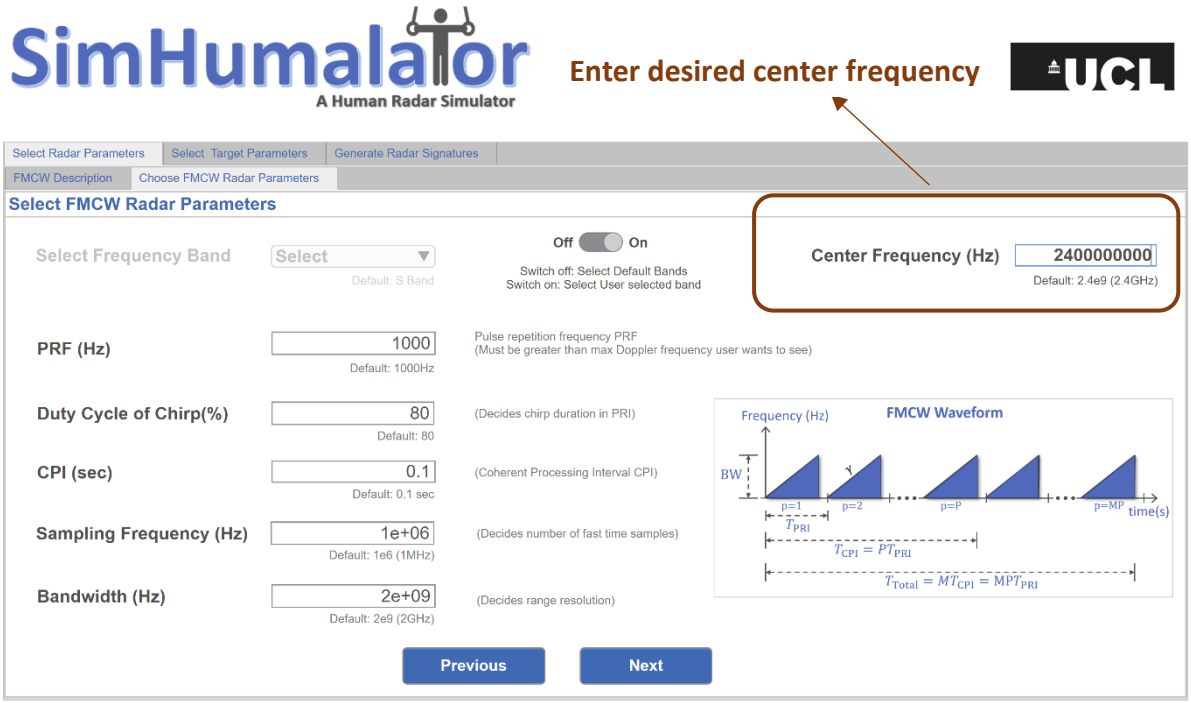
c. Bands switch is by default off.



d. If band switch is off, then select the frequency from the bands available in the drop-down menu

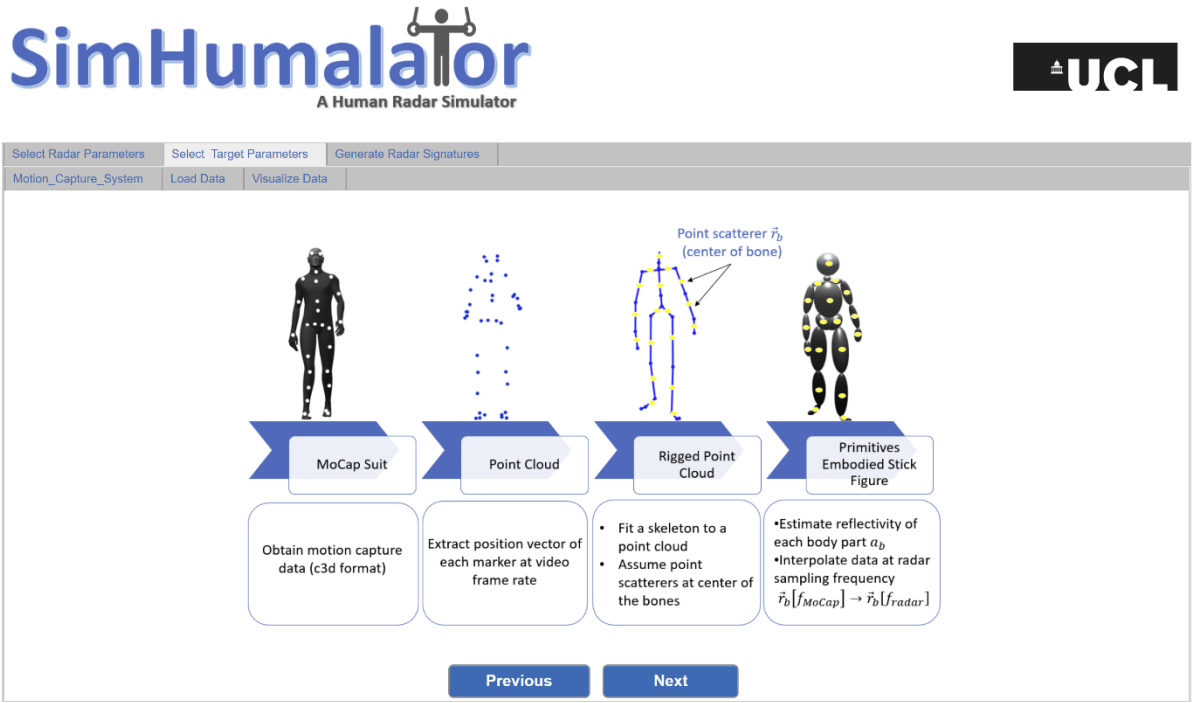


e. **If ON, then enter desired center frequency for FMCW waveform**

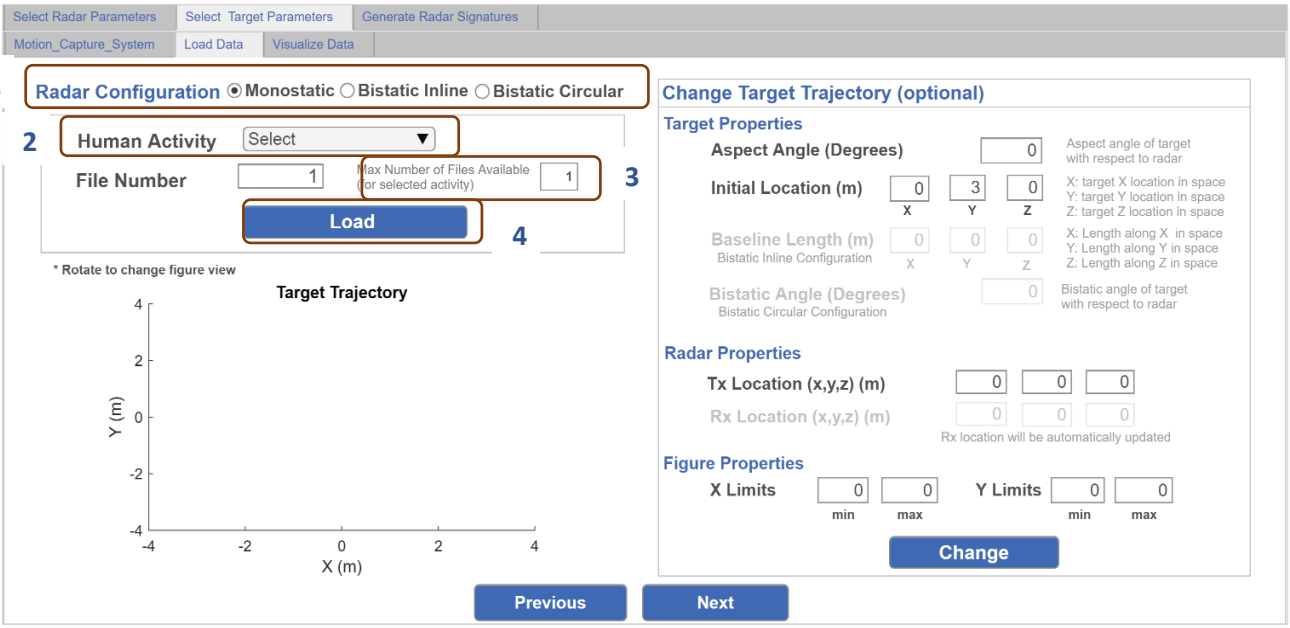


f. **Enter other parameters such as PRF, Duty cycle, CPI, Sampling frequency and Bandwidth. If not entered, will select the default values**

g. **Press Next to enter target parameter selection tab. This tab shows the simulation methodology to generate target data based on motion capture system**

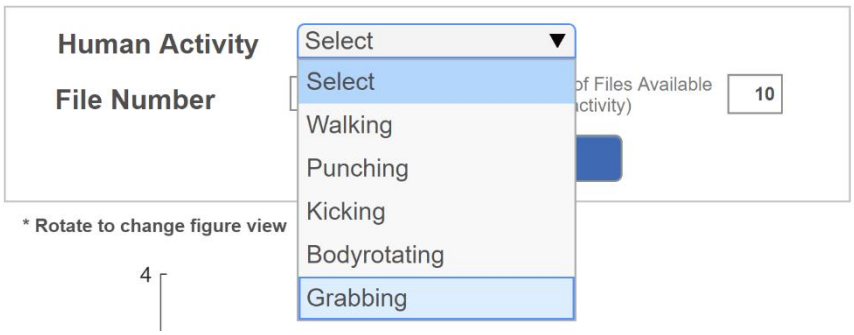


h. **Press Next to load target data**



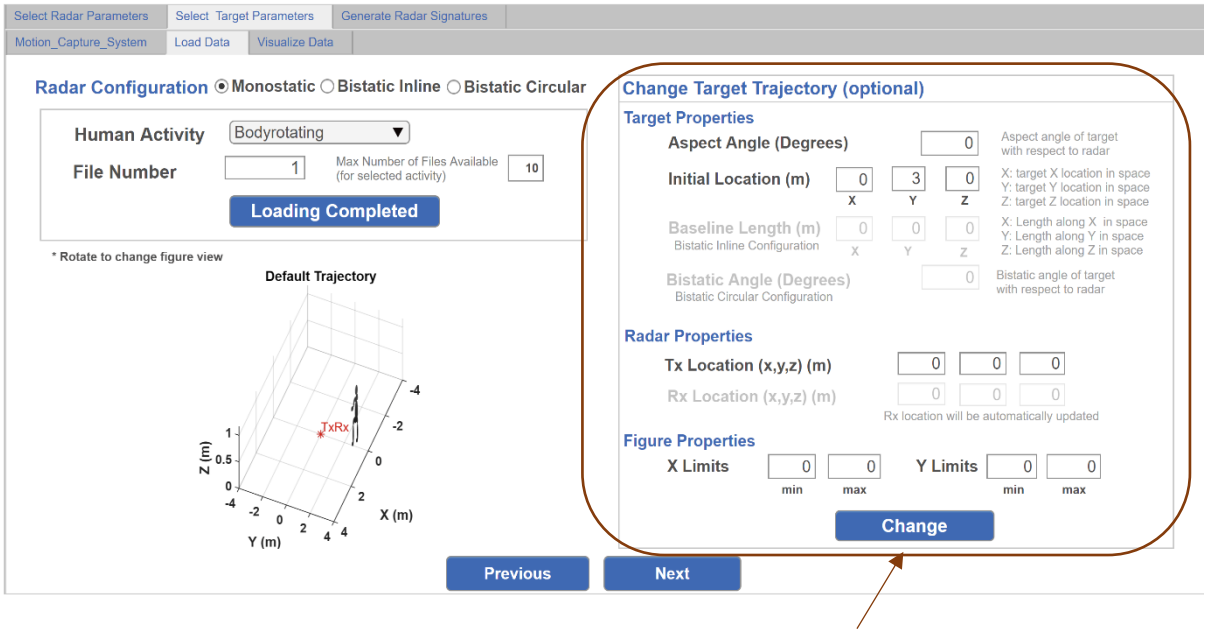
i. **First select the desired radar configuration**

ii. **Select the desired activity from the drop-down menu**



iii. **Once the activity is selected, the box marked red in 3 will display the number of files available in each activity category. For instance, Human body rotating has 10 files. User can enter the file number to generate data corresponding to a file.**

iv. **file number is entered, hit the load button. Figure on the bottom will display the human position in space with respect to radar**



v. **Change the target trajectory parameters from the panel on the right-hand side and press change button. Once changes are fixed, press Next button.**

i. **Next page displays the ground truth signatures of the target- range-time and velocity-time.**

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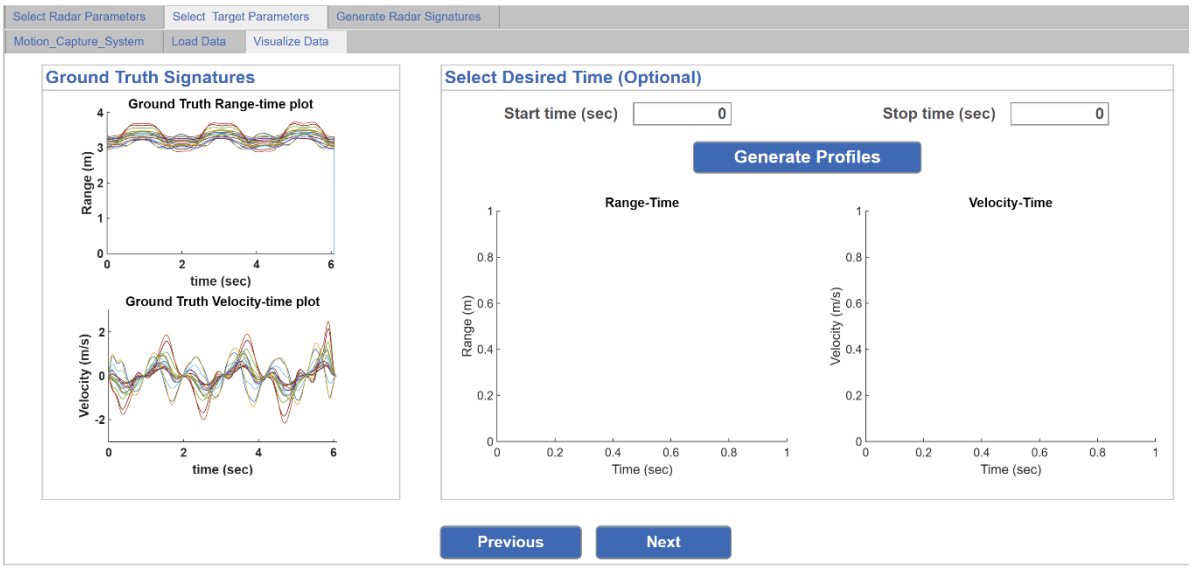
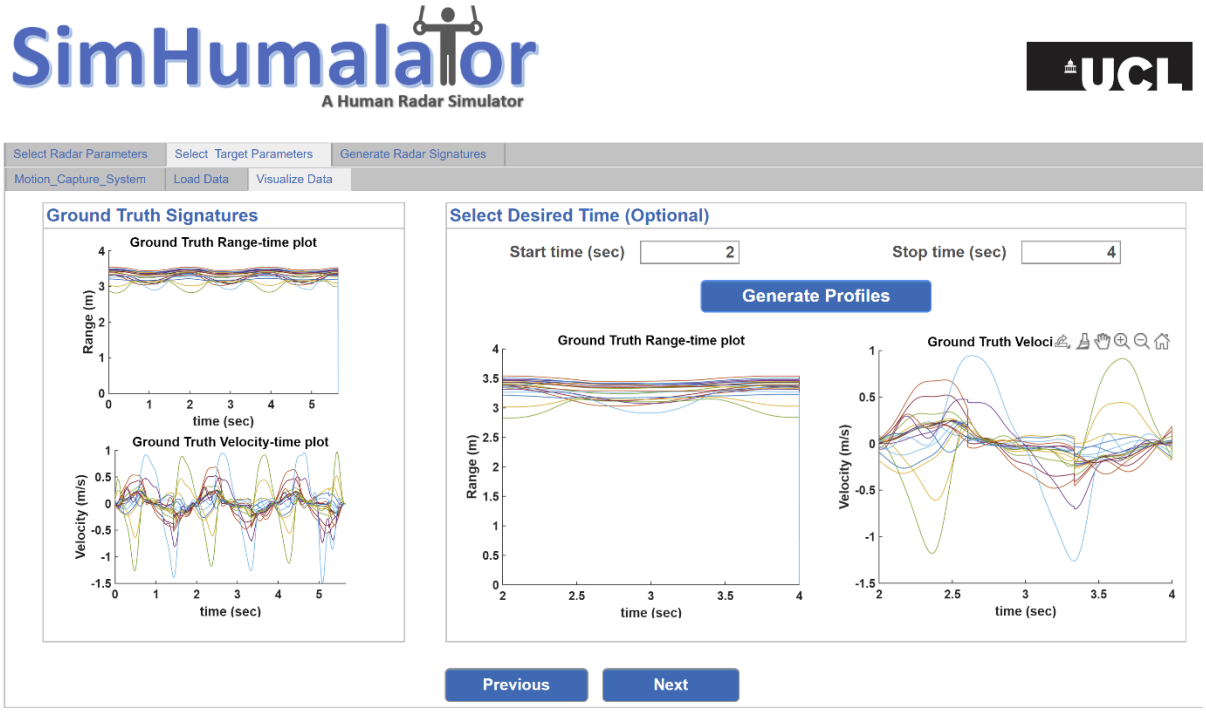
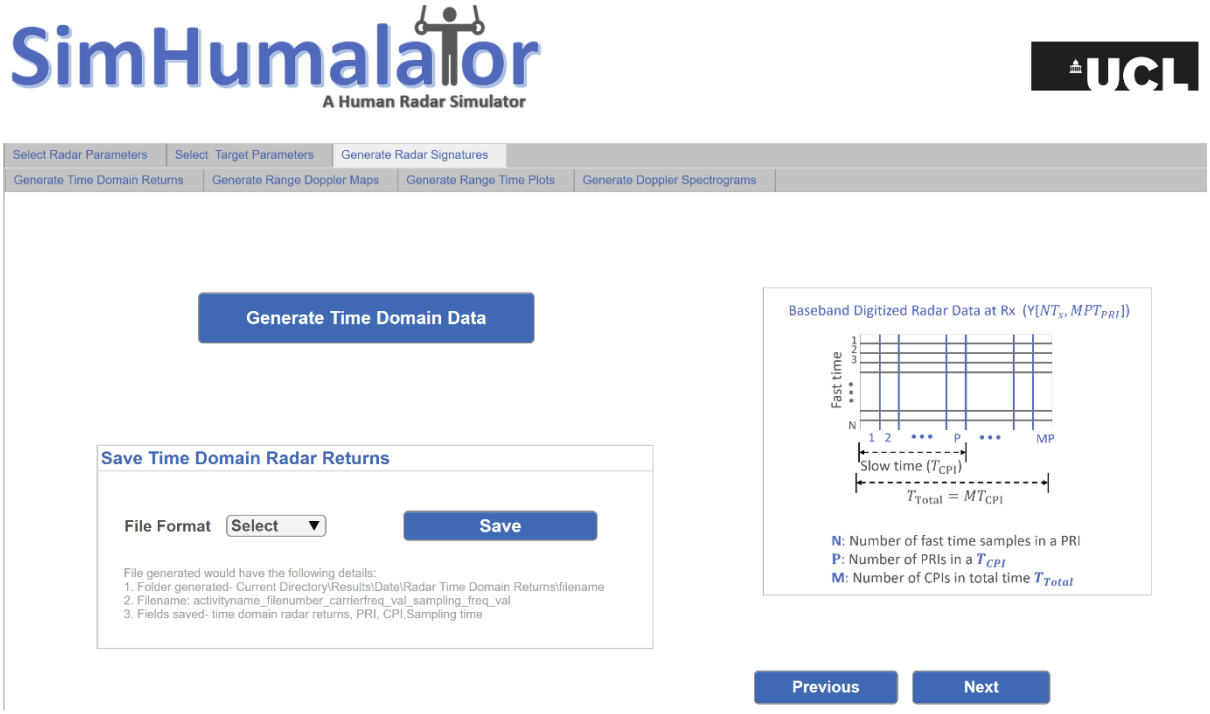


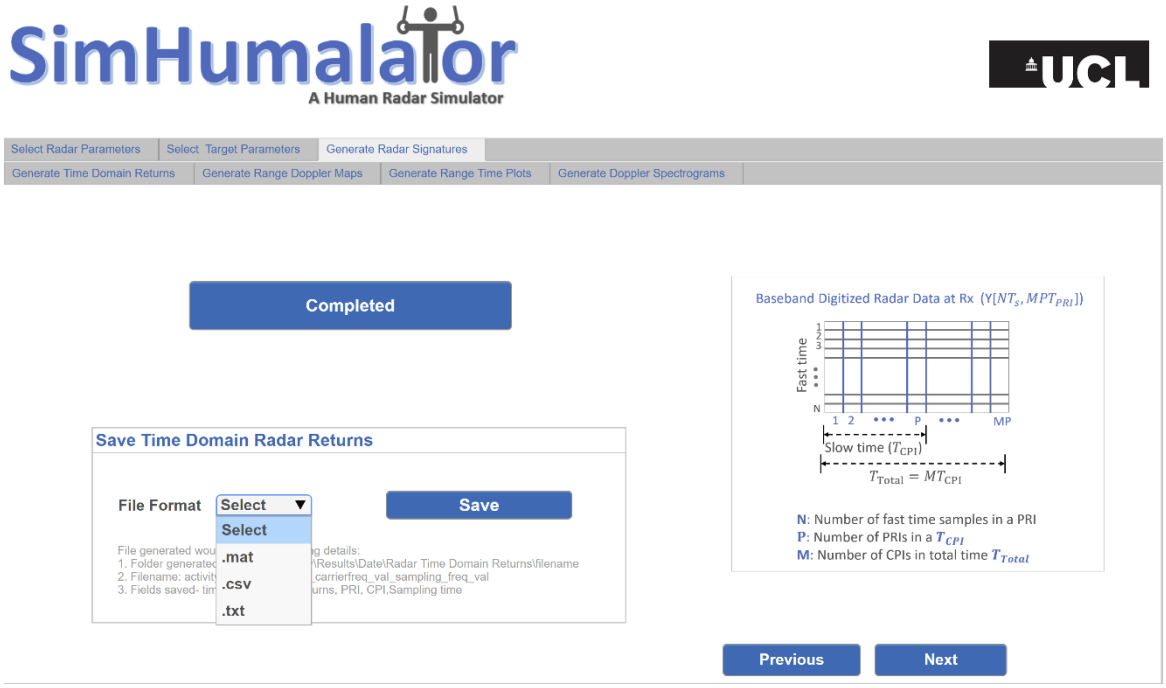
j. **If want to capture the entire data, then directly press Next button otherwise first enter the start time and the stop time to select the desired duration then, press Generate Profiles button. Once desired time duration is selected, press Next button.**



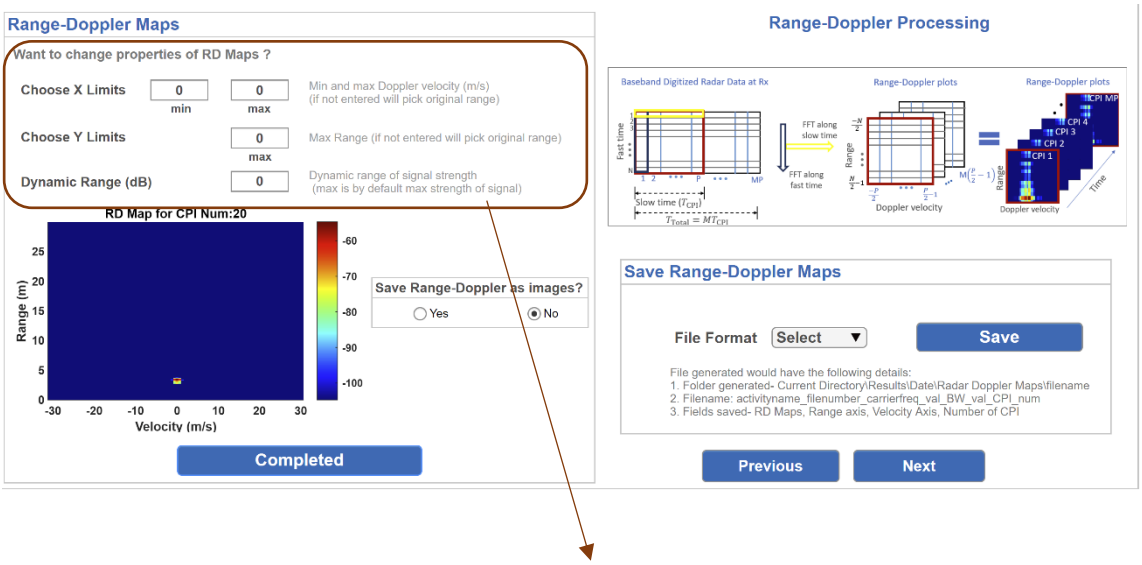
k. This page belongs to radar signatures tab. Press Generate Time Domain Data to generate the radar returns from dynamic human activity for a selected configuration of radar



l. Once generated, select the file format for saving the time domain radar returns

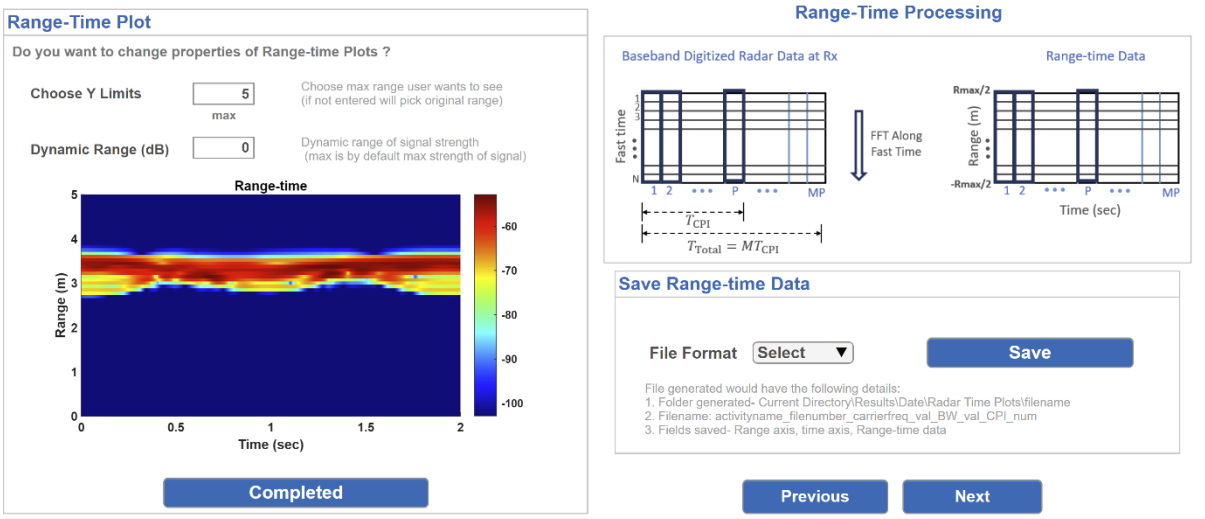


m. **Press Next to generate Range-Doppler Maps. Users can save the range-Doppler maps from the drop-down menu.**

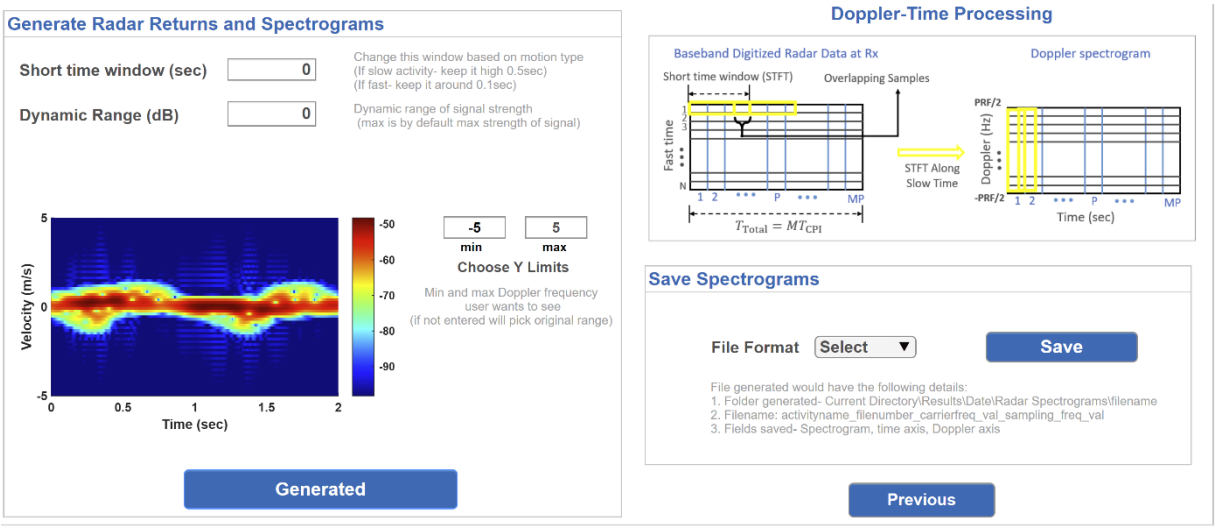


If not entered will pick default values based on the selected radar parameters

n. **Next page will generate the range-time profiles. Please note that if the values are not entered, default values will be picked up for the dynamic range, axis limits. Users can change the axis limits.**



o. **Next page will generate the Doppler-time plots. Please note that if the values are not entered, default values will be picked up for the dynamic range, axis limits and short time window. Users can change these values.**



4. Saved Files

Please note that the files will be saved in the current directory of the simulator. Folders would be generated independently for each signature type- time domain returns, range-time data, Doppler-time data, range-Doppler data. Withing each of these folders, another folder would be generated corresponding to the selected target activity and the file number corresponding to the selected activity. Detailed description of file being saved is given below the save button.